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Matsuzaki et al.

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(54) **CLEANING DEVICE, DEVELOPING DEVICE, CARTRIDGE, CLEANING BLADE SECURING METHOD, AND DEVELOPING BLADE SECURING METHOD**

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Related U.S. Application Data

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G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/0029*** (2013.01); ***G03G 15/0812*** (2013.01); *G03G 21/0011* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0812; G03G 21/0011; G03G 21/0029
USPC 399/123, 284, 351; 411/23, 82.1
See application file for complete search history.

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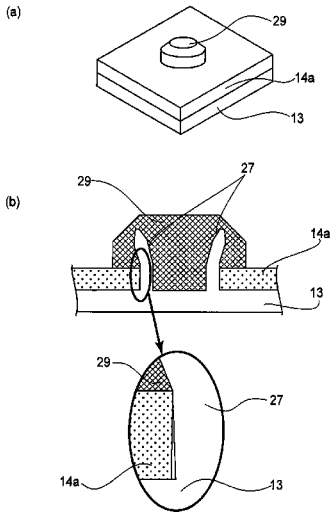
(57) **ABSTRACT**

A cleaning device having a cleaning blade for removing toner remaining on a surface of an image bearing member; a cleaning unit frame (or a developing unit frame) for supporting the cleaning blade; and a plurality of projections provided on the cleaning (developing) unit frame. The projections are bent outwardly to secure the cleaning blade to the cleaning unit frame. Alternatively, a projection is provided on the cleaning (developing) unit frame having a recess, where the recess expands outwardly from a base portion of the projection to a free end of the projection to secure the cleaning blade to the cleaning (developing) unit frame.

29 Claims, 12 Drawing Sheets



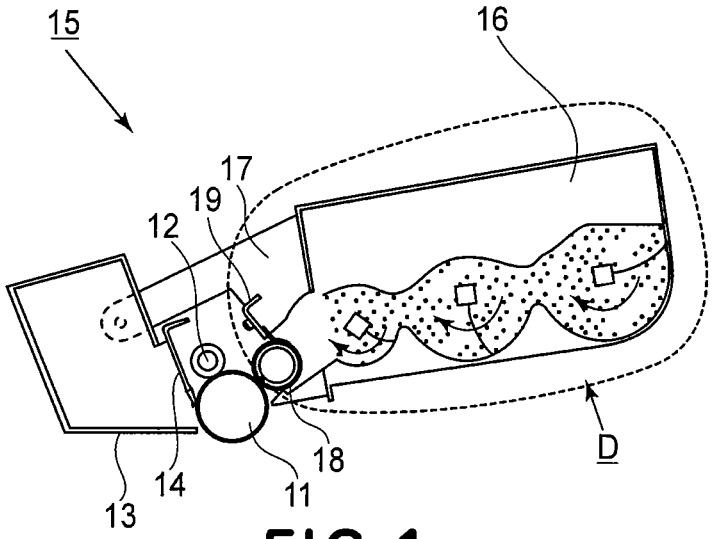


FIG.1

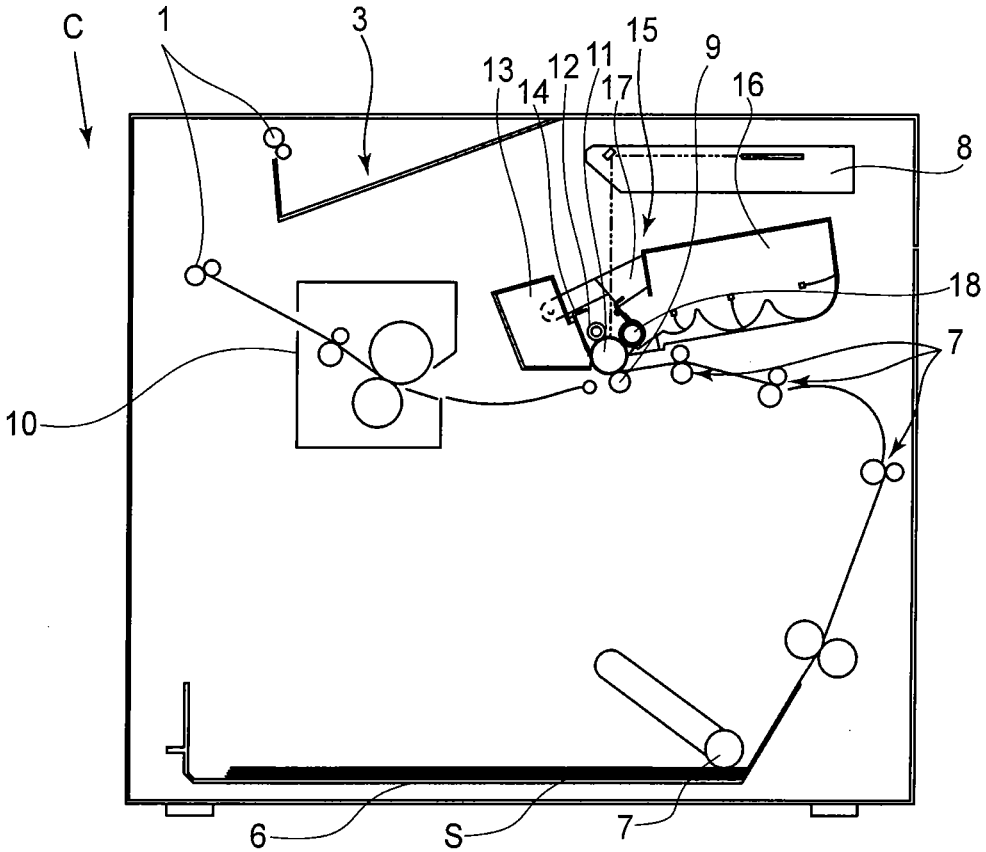
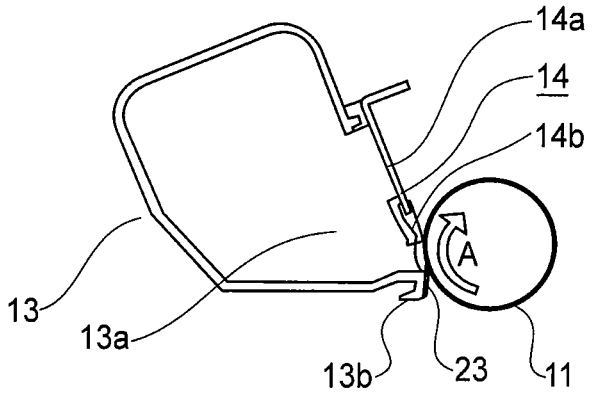


FIG.2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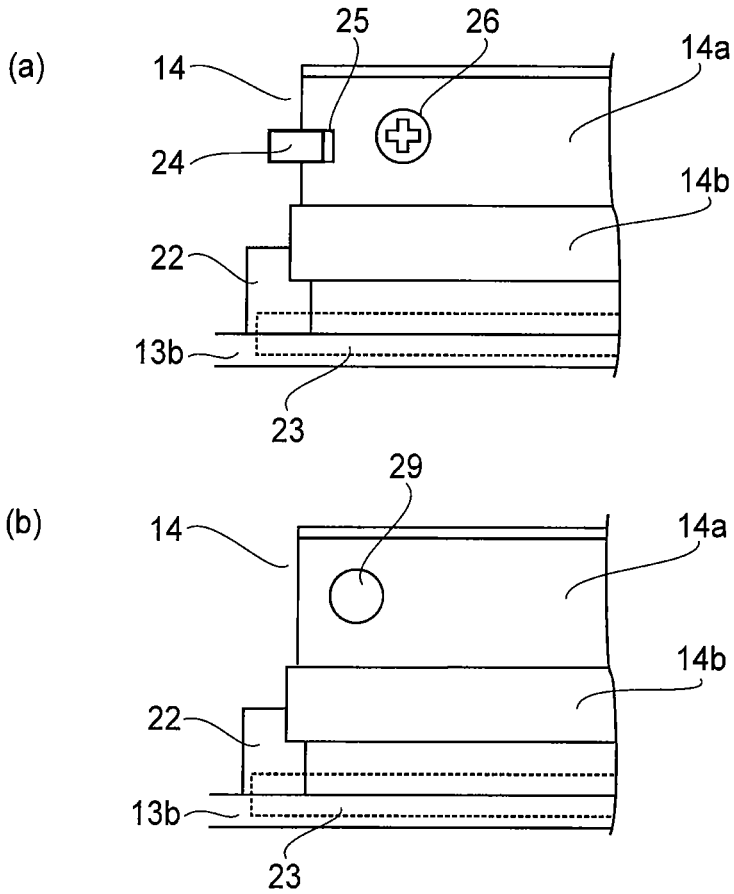
14
14b
A
13
13a
13b
23
11

FIG.3


(a)
25
26
14
14a
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14b
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(b)
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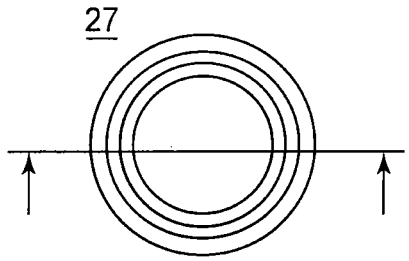
22
13b
23

FIG.4

(a)



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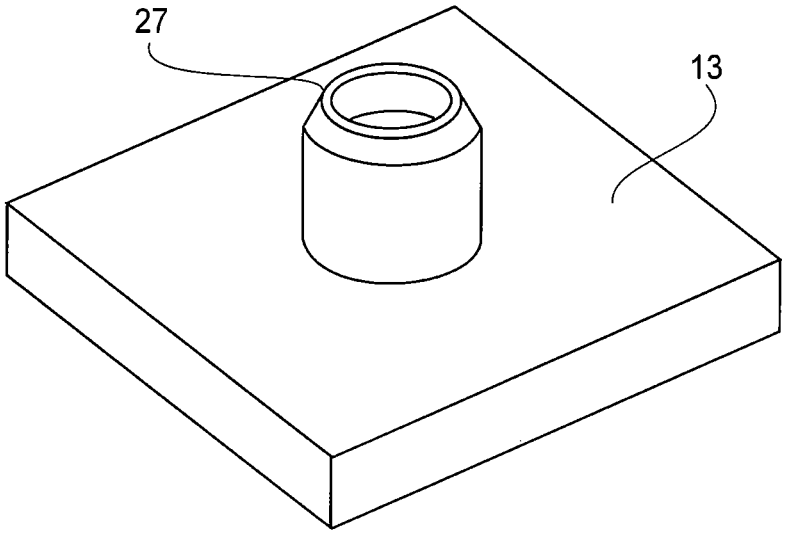


FIG.5

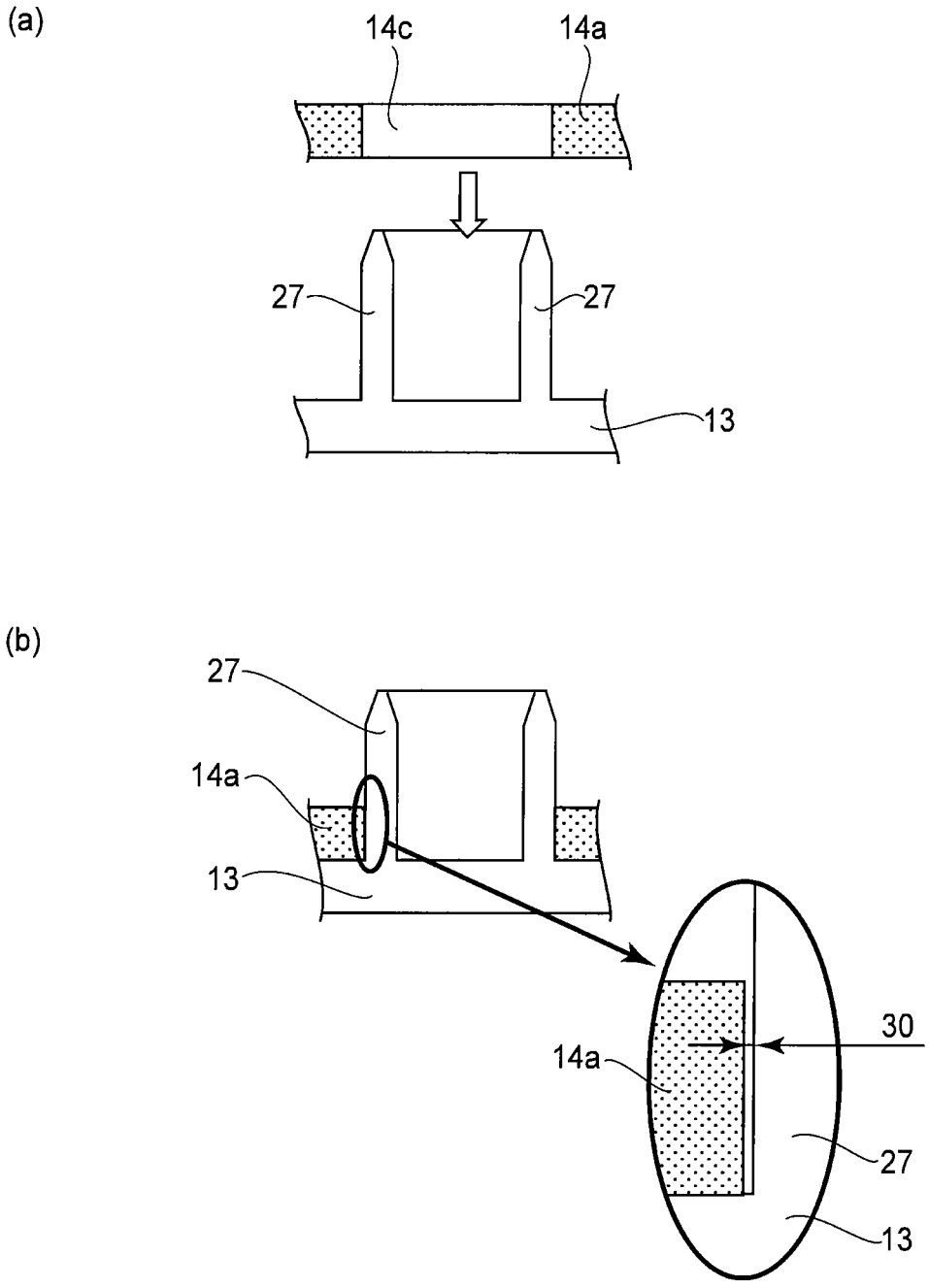


FIG.6

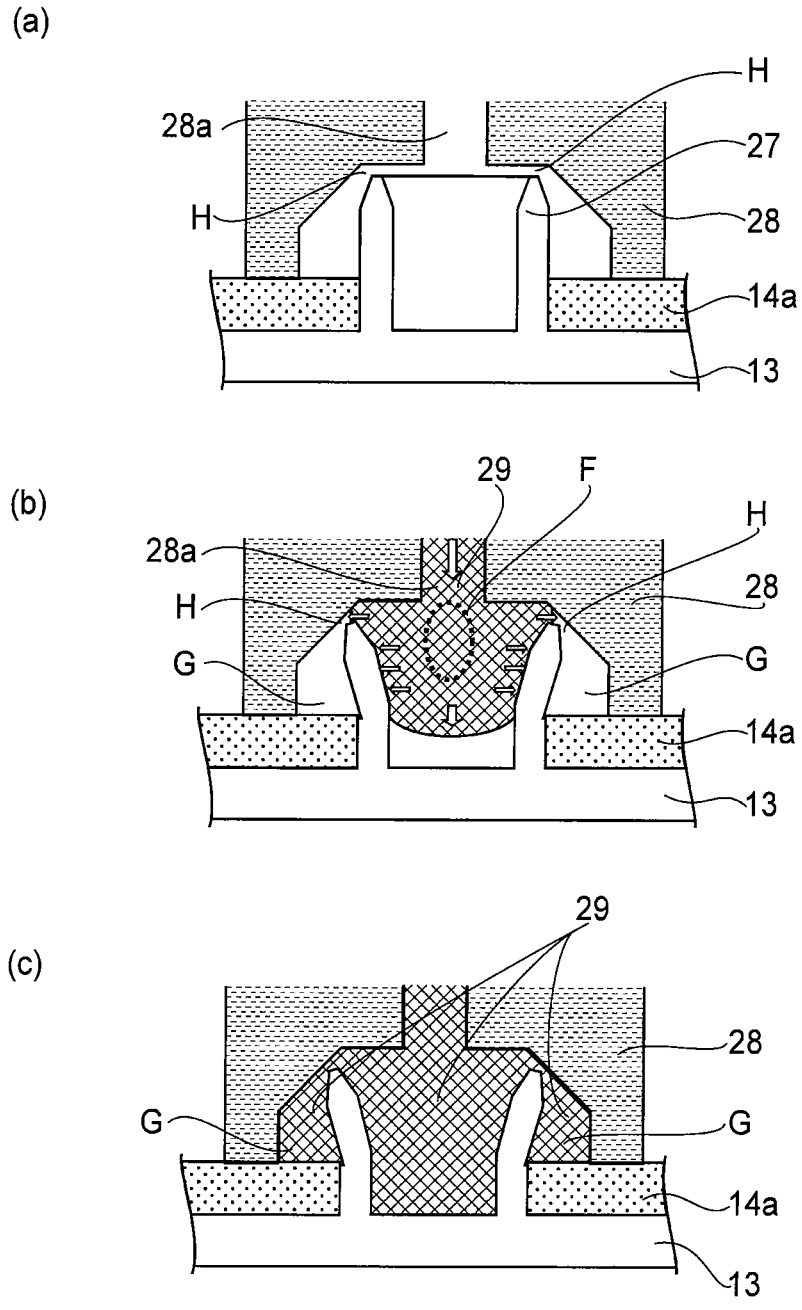


FIG.7

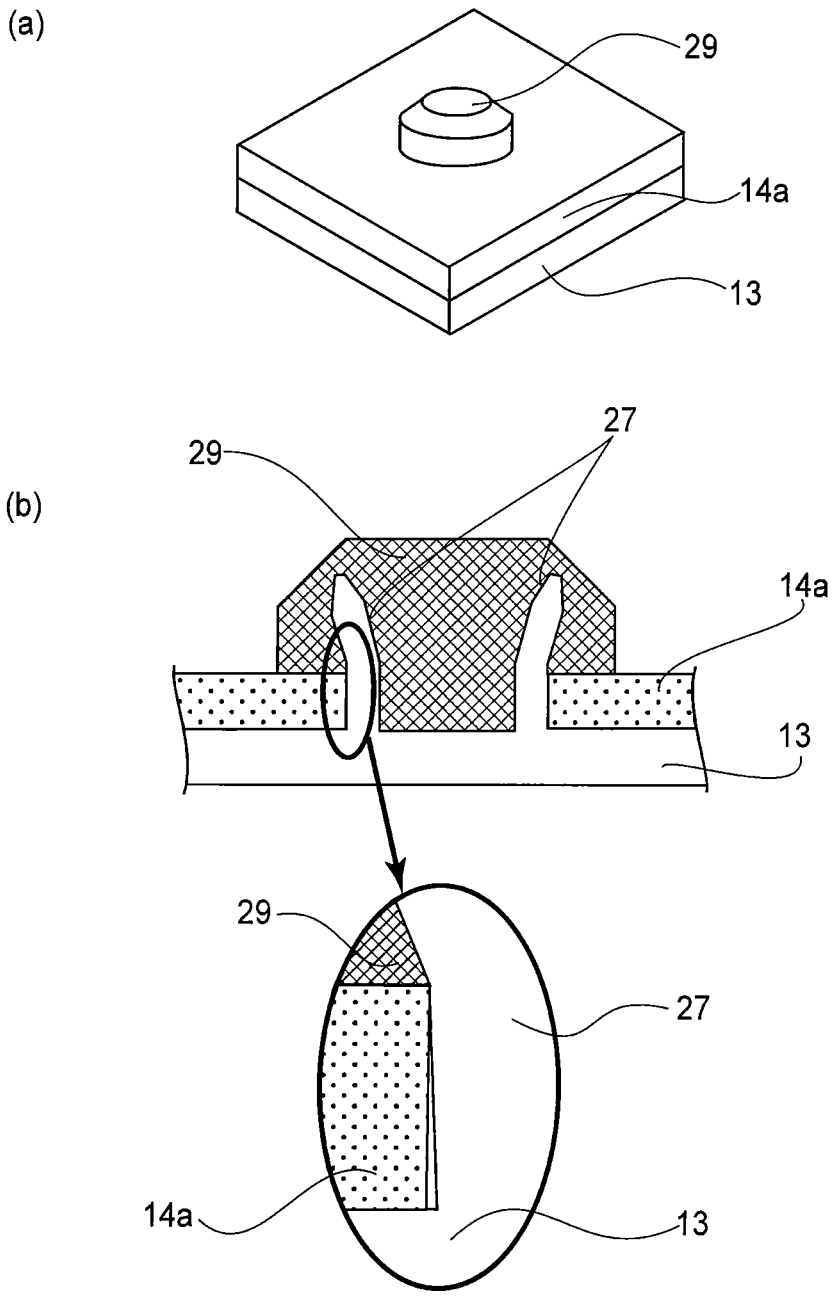
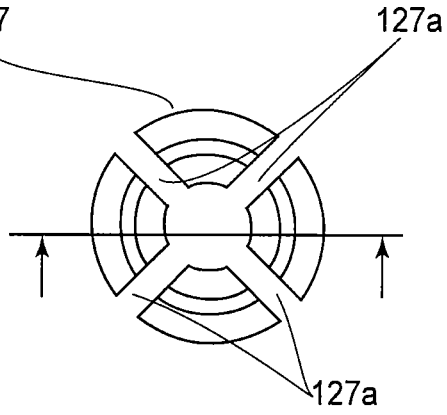


FIG.8

(a)



(b)

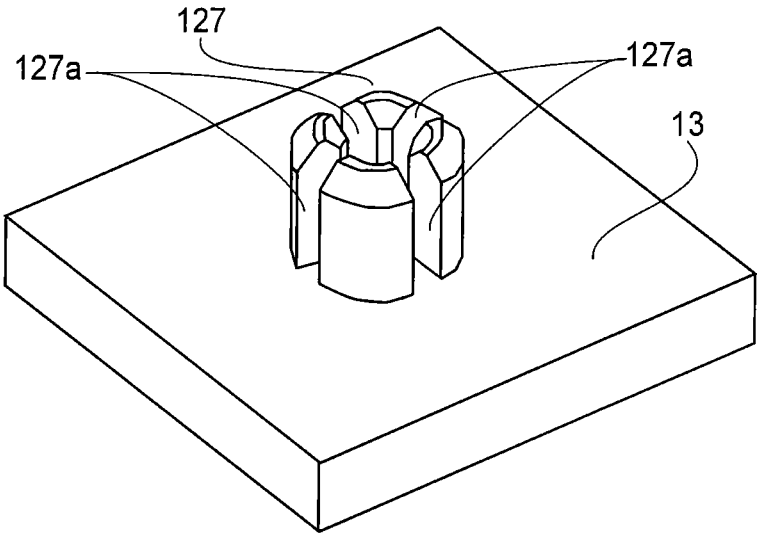
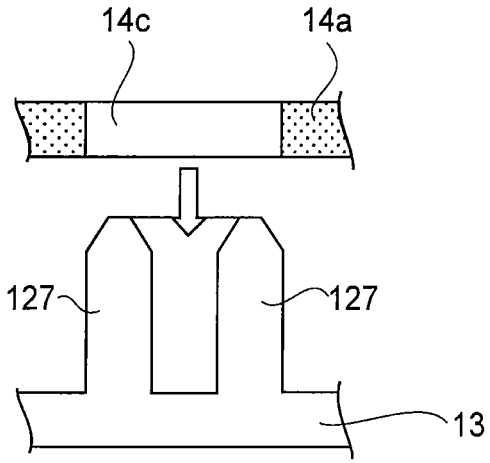


FIG.9

(a)



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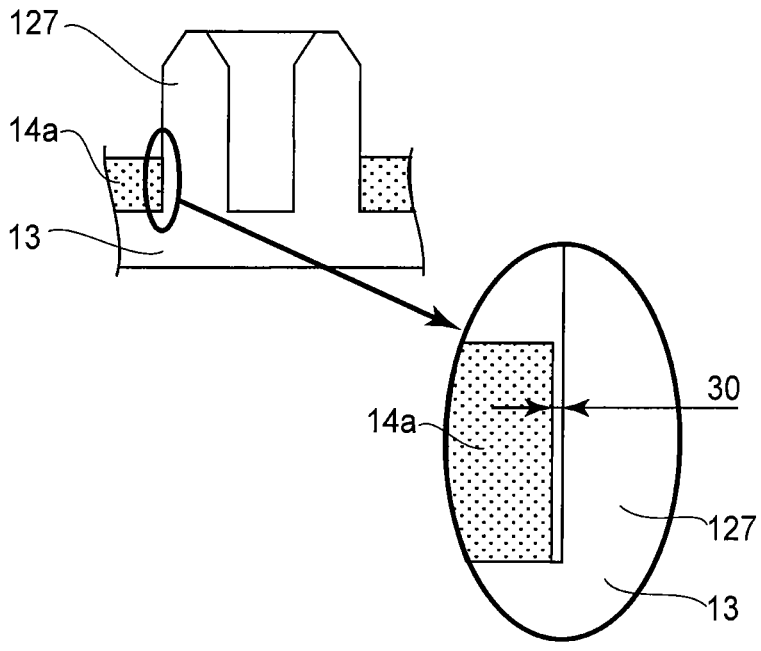

FIG.10

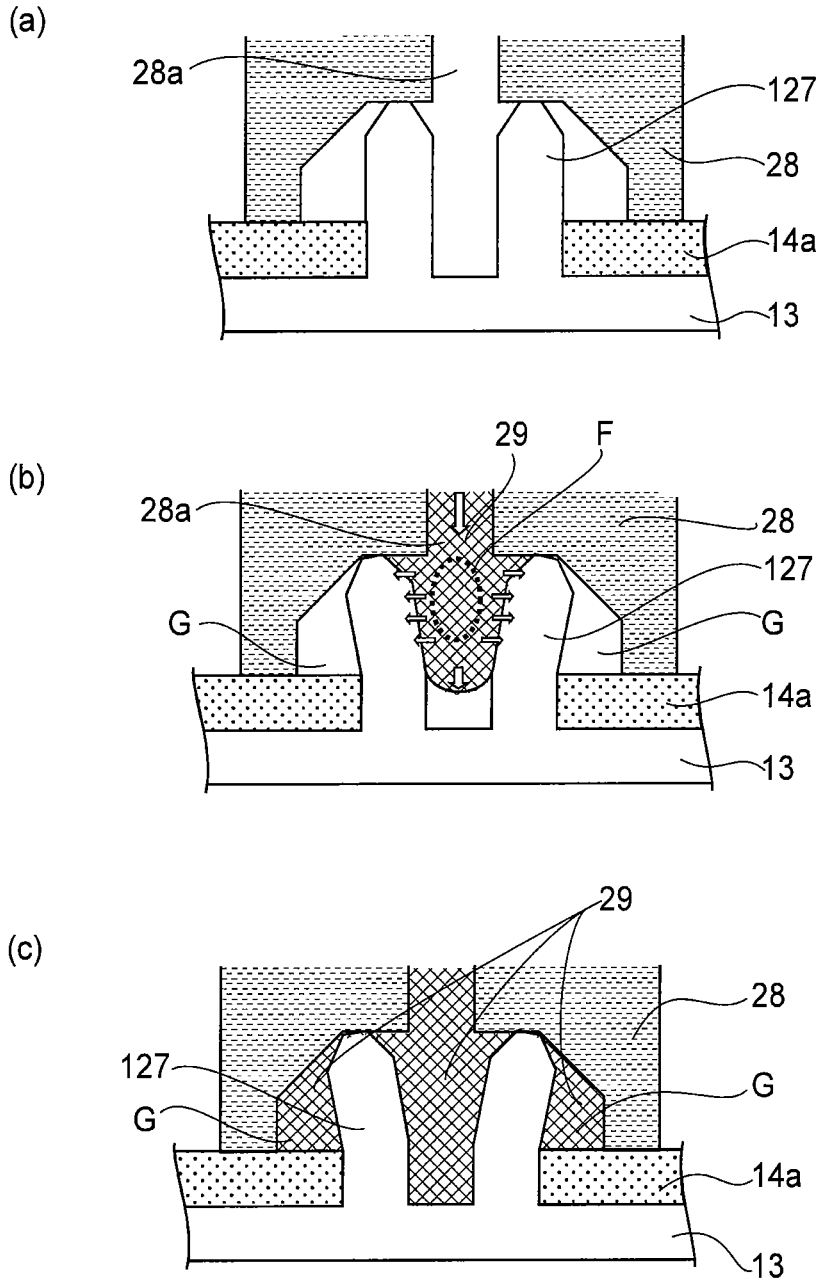

FIG.11

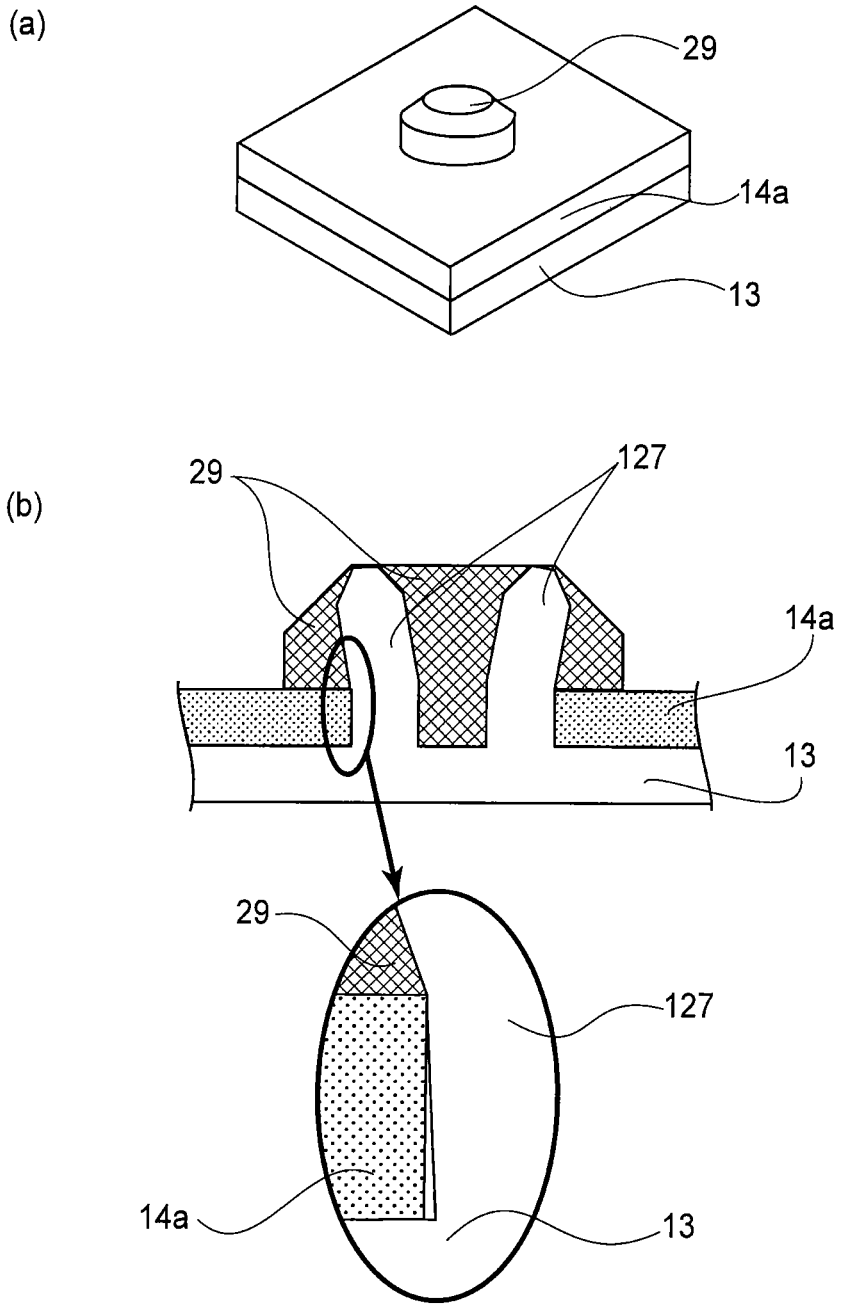

FIG.12

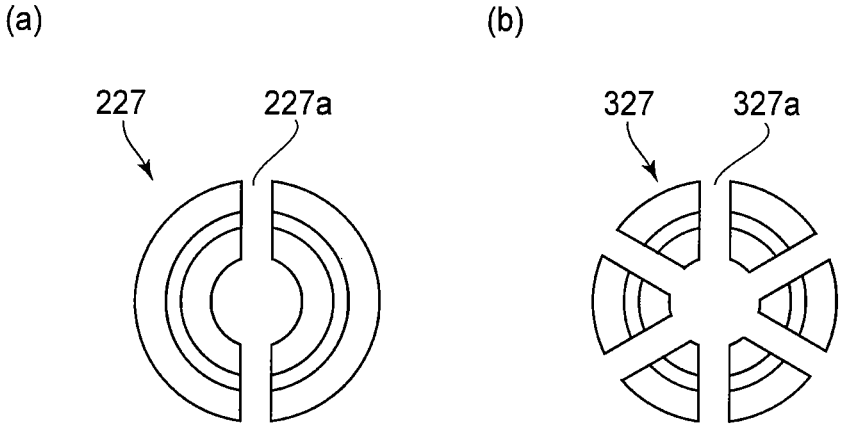

FIG.13

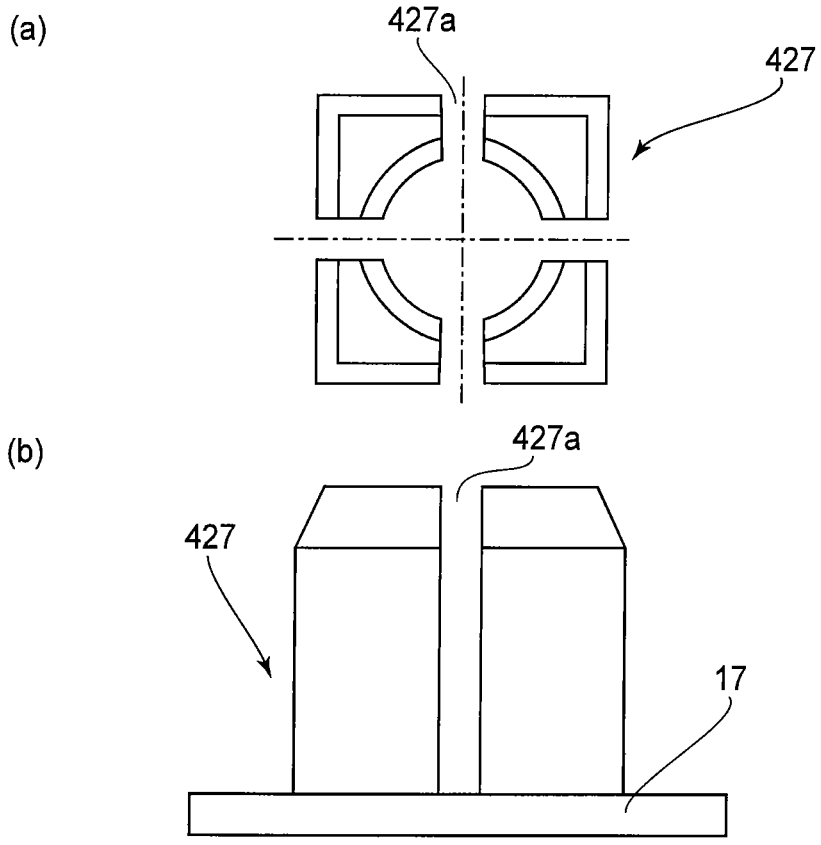

FIG.14

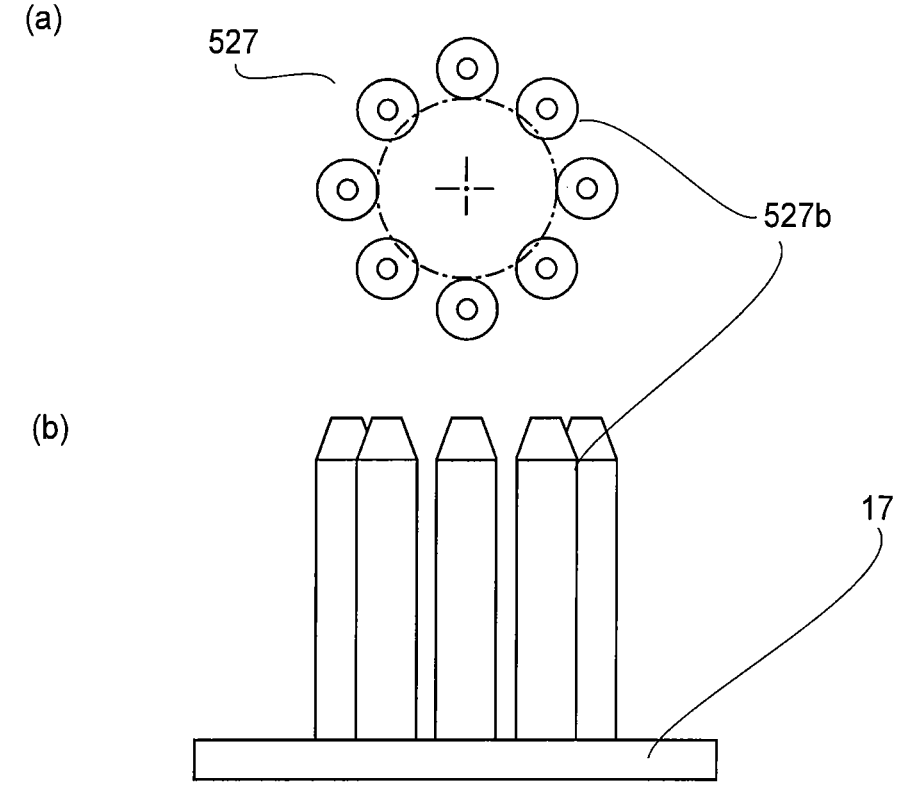

FIG.15

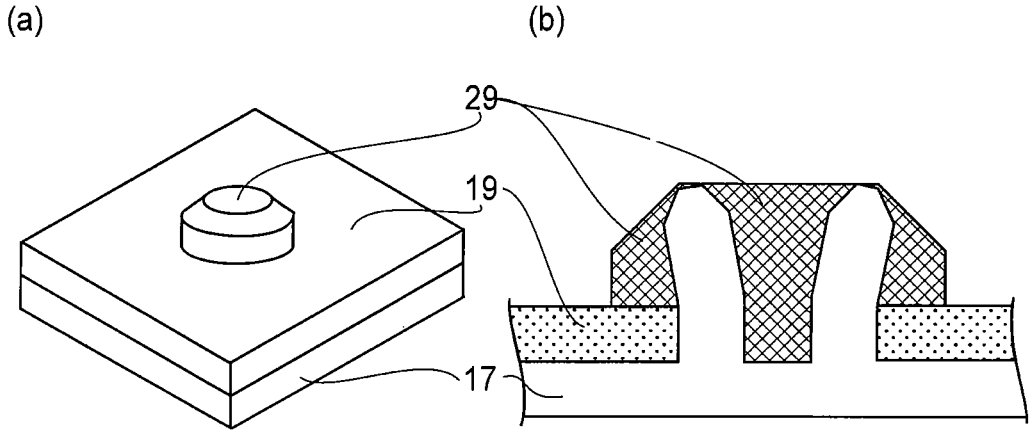

FIG.16

CLEANING DEVICE, DEVELOPING DEVICE, CARTRIDGE, CLEANING BLADE SECURING METHOD, AND DEVELOPING BLADE SECURING METHOD

This application is a divisional of U.S. patent application Ser. No. 13/270,567, filed Oct. 11, 2011 now U.S. Pat. No. 8,285,189, which is a divisional of U.S. patent application Ser. No. 12/711,500, filed Feb. 24, 2010, now U.S. Pat. No. 8,073,377.

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a cleaning device, a developing device, a cartridge, a method for securing a cleaning blade, and a method for securing a development blade.

Here, a cleaning device (cleaning blade), and a developing device (development blade) are such apparatuses that are used in an electrophotographic image forming apparatus.

Further, an electrophotographic image forming apparatus is an apparatus for forming an image on a recording medium with the use of an electrophotographic image formation process. It includes an electrophotographic copying machine, an electrophotographic printer (LED printer, laser beam printer, etc., for example), an electrophotographic facsimile apparatus, an electrophotographic word processor, and the like.

Further, a cartridge means a process cartridge which contains a minimum of a developing means placed in the cartridge (shell) to make the developing means removably mountable in the main assembly of an image forming apparatus, or a process cartridge which contains an image bearing member, and a cleaning means for removing the developer on the peripheral surface of the image bearing member, which are integrally placed in the cartridge (shell) to make them removably mountable in the main assembly of an image forming apparatus.

Conventionally, a piece of metallic plate which supports a cleaning blade for removing the developer (which hereafter will be referred to as "toner"), or a piece of metallic plate which supports a developer regulating member for regulating the toner on a developer bearing member, are attached with the use of screws (Japanese Laid-open Patent Application 2003-177644; FIGS. 9 and 10).

However, using screws to attach the metallic plate sometimes creates the following problems. That is, when manufacturing metallic screws, some screws come out with tiny pieces of metal of which the screws are made of, or tiny pieces of metal with which the screws are plated. These tiny pieces of metal remain attached to the screws. Further, when manufacturing resin screws, some screws come out with tiny pieces of resin, and these tiny pieces of resin remain attached to the screws. Further, some of these screws are shipped out in a bundle. Thus, the screws rub against each other during shipping, and therefore, some of the tiny metallic or resin pieces sometimes become separated from the screws. Further, as these screws having tiny metallic or resin pieces are tightened, the tiny metallic or resin pieces sometimes separate from the screws as they come into contact with the screw driver. Moreover, some of the tiny pieces of metal or resin having separated from the screws fall into a process cartridge. This creates problems. That is, in the case of some process cartridges, their photosensitive drums, charge rollers, development rollers, etc., are disposed below where the abovementioned screws are attached, because of the structure of the process cartridges. Thus, it is possible that the separated tiny pieces of metal or resin will adhere to the photosensitive drums, charge rollers, development rollers, etc. Thus, a process for cleaning each cartridge, and/or a process for examining each cartridge, becomes necessary. Besides, in recent years, a required level of image quality has become higher and higher. Thus, in order to achieve the higher level of image quality, the cleaning process and/or the examining process has to be more rigidly carried out. Also in recent years, process cartridges have been substantially reduced in size, making it necessary to reduce in size the metallic plate for supporting the cleaning blade and developer regulating member.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a cleaning device, a developing device, and a cartridge, to which a blade can be easily attached, and a blade attaching method which is easier than any of the conventional blade attaching methods.

According to an aspect of the present invention, there is provided a cleaning device comprising a cleaning blade for removing toner remaining on a surface of an image bearing member for carrying a toner image; a supporting member for supporting said cleaning blade; a mounting hole provided in one of said cleaning blade and said supporting member; a projection which is provided on the other of said cleaning blade and said supporting member and which is inserted in said mounting hole; and a recess provided in said projection and extended from a free end portion of said projection toward a base portion of said projection, wherein said cleaning blade and said supporting member are secured to each other by said projection deformed such that said recess expands outwardly of said mounting hole by resin material in said recess.

According to another aspect of the present invention, there is provided a developing device comprising a developing blade for regulating toner to be applied on a developing roller; a supporting member for supporting said developing blade; a mounting hole provided in one of said developing blade and said supporting member; a projection which is provided on the other of said developing blade and said supporting member and which is inserted in said mounting hole; and a recess provided in said projection and extended from a free end portion of said projection toward a base portion of said projection, wherein said developing blade and said supporting member are secured to each other by said projection deformed such that said recess expands outwardly of said mounting hole by resin material in said recess.

According to a further aspect of the present invention, there is provided a cleaning blade securing method for securing a cleaning blade for a cleaning device, wherein said cleaning blade is effective to remove toner remaining on a surface of an image bearing member for carrying a toner image, and said cleaning device includes a supporting member for supporting said cleaning blade; a mounting hole provided in one of said cleaning blade and said supporting member; a projection which is provided on the other of said cleaning blade and said supporting member and which is inserted in said mounting hole; a recess provided in said projection and extended from a free end portion of said projection toward a base portion of said projection, said method comprising steps of inserting said projection into said mounting hole; injecting molten resin material into said recess to deform said projection so as to expand said recess outwardly of said mounting hole by a pressure of the resin material; and curing the resin material to secure said cleaning blade to said supporting member.

According to a further aspect of the present invention, there is provided a developing blade securing method for securing

a developing blade for a developing device, wherein said developing blade is effective to regulate toner to be applied on a developing roller, and said developing device includes a supporting member for supporting said developing blade; a mounting hole provided in one of said developing blade and said supporting member; a projection which is provided on the other of said developing blade and said supporting member and which is inserted in said mounting hole; a recess provided in said projection and extended from a free end portion of said projection toward a base portion of said projection, said method comprising inserting said projection into said mounting hole; injecting molten resin material into said recess to deform said projection so as to expand said recess outwardly of said mounting hole by a pressure of the resin material; and curing the resin material to secure said developing blade to said supporting member.

These and other objects, features, and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of the process cartridge in the first preferred embodiment of the present invention, at a plane which corresponds in position to the most essential portion of the process cartridge.

FIG. **2** is a sectional view of the image forming apparatus in the first preferred embodiment of the present invention, at a plane which corresponds in position to the most essential portion of the image forming apparatus.

FIG. **3** is a sectional view of the cleaning unit in the first preferred embodiment of the present invention.

FIG. **4**(*a*) is a drawing which shows the general structure of a conventional cleaning unit, and FIG. **4**(*b*) is a drawing which shows the general structure of the cleaning unit in the first preferred embodiment.

FIG. **5**(*a*) is a top plan view of the one of the bosses of the cleaning unit frame in the first preferred embodiment of the present invention, and FIG. **5**(*b*) is a perspective view of one of the bosses of the cleaning unit frame in the first preferred embodiment of the present invention.

FIG. **6**(*a*) is a schematic sectional view of a combination of the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, in the first preferred embodiment of the present invention, and FIG. **6**(*b*) is an enlarged sectional view of the combination of the metallic plate of the cleaning blade, cleaning unit frame, and one of the bosses of the cleaning unit frame, in the first preferred embodiment of the present invention.

FIG. **7**(*a*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, prior to the resin injection, in the first preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame. FIG. **7**(*b*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, during the resin injection, in the first preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame. FIG. **7**(*c*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, after the resin injection, in the first preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame.

FIG. **8**(*a*) is a perspective view of a combination of the solidified body of resin, one of the bosses of the cleaning unit frame, the metallic plate of the cleaning blade, and the cleaning unit frame, after the completion of the process of attaching the metallic plate to the cleaning unit frame, in the first preferred embodiment of the present invention, and FIG. **8**(*b*) is a sectional view of the combination of the solidified body of resin, one of the bosses of the cleaning unit frame, the metallic plate of the cleaning blade, and the cleaning unit frame, after the completion of the process of attaching the metallic plate to the boss of the cleaning unit frame, in the first preferred embodiment of the present invention.

FIG. **9**(*a*) is top plan view of one of the bosses of the cleaning unit frame in the second preferred embodiment of the present invention, and FIG. **9**(*b*) is a perspective view of one of the bosses of the cleaning unit frame in the second preferred embodiment of the present invention.

FIG. **10**(*a*) is a schematic sectional view of a combination of the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, in the second preferred embodiment of the present invention, and FIG. **10**(*b*) is a sectional view, including a partial enlargement, of the combination of the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, in the second preferred embodiment of the present invention.

FIG. **11**(*a*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, prior to the resin injection, in the second preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame. FIG. **11**(*b*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, during the resin injection, in the second preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame. FIG. **11**(*c*) is a schematic sectional view of the jig for attaching the metallic plate of the cleaning blade, the metallic plate of the cleaning blade, the cleaning unit frame, and one of the bosses of the cleaning unit frame, after the resin injection, in the second preferred embodiment. It shows the state of connection between the metallic plate and cleaning unit frame.

FIG. **12**(*a*) is a perspective view of a combination of the solidified body of resin, one of the bosses of the cleaning unit frame, the metallic plate of the cleaning blade, and the cleaning unit frame, after the completion of the process of attaching the metallic plate to the cleaning unit frame, in the second preferred embodiment of the present invention, and FIG. **12**(*b*) is a sectional view, including an enlarge view, of the combination of the solidified body of resin, one of the bosses of the cleaning unit frame, the metallic plate of the cleaning blade, and the cleaning unit frame, after the completion of the process of attaching the metallic plate to the cleaning unit frame the boss, in the second preferred embodiment of the present invention.

FIG. **13**(*a*) is a top plan view of one of the bosses of the cleaning unit frame, which is made up of two equal pieces (halves), in the third preferred embodiment of the present invention, and FIG. **13**(*b*) is a top plan view of one of the bosses of the cleaning unit frame, which is made up of six equal pieces.

FIG. **14**(*a*) is a top plan view of the boss in the fourth preferred embodiment of the present invention, and FIG. **14**(*b*) is a side view of the boss in the fourth preferred embodiment of the present invention.

FIG. **15**(*a*) is a top plan view of one of the bosses of the cleaning unit frame in the fifth preferred embodiment of the present invention, and FIG. **15**(*b*) is a side view of the boss in FIG. **15**(*a*), in the fifth preferred embodiment of the present invention.

FIG. **16**(*a*) is a perspective view of a combination of the solidified resin, one of the bosses of the development unit frame, the metallic plate of the development blade, and the development unit frame, in the sixth preferred embodiment of the present invention, and FIG. **16**(*b*) is a sectional view of the combination in FIG. **16**(*a*), in the sixth preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

[Overall Structure of Image Forming Apparatus]

FIG. **1** is a sectional view of the process cartridge, in the first preferred embodiment of the present invention, which has a development unit to which the present invention is applicable, at a plane which corresponds in position to the essential portion of the process cartridge. FIG. **2** is a sectional view of the image forming apparatus, in the first preferred embodiment of the present invention, to which the present invention is applicable, at a plane which corresponds in position to the essential portion of the image forming apparatus. The process cartridge in this embodiment is provided with an image bearing apparatus, and a processing means which processes the image bearing member. The cartridge is removably mountable in the image forming apparatus in FIG. **2**. As the processing means, there are a charging means for charging the peripheral surface of the image bearing member, a developing device for forming an image on the image bearing member, and a cleaning device for removing the toner remaining on the peripheral surface of the image bearing member, for example.

Referring to FIG. **1**, a process cartridge **15** has a photosensitive drum **11** and a charge roller **12**. The photosensitive drum **11** holds a toner image. The charge roller **12** is a charging means, and is in the adjacencies of the peripheral surface of the photosensitive drum **11**. The process cartridge **15** has also a development unit D (developing device), which has a development roller **18**, a development blade **19**, and a toner storage container **16** in which toner is stored. The process cartridge **15** has also an elastic cleaning blade **14** as a cleaning means. Further, the process cartridge **15** has a housing in which the abovementioned components are integrally held. It is removably mountable in the main assembly C of the image forming apparatus.

From a sheet cassette **6** mounted in the bottom portion of the main assembly C of the image forming apparatus, a sheet S of recording medium is conveyed into the main assembly C by a sheet conveyance roller **7**. In synchronism with this conveyance of the sheet S, a latent image is formed on the peripheral surface of the photosensitive drum **11** by selectively exposing the numerous points of the peripheral surface of the photosensitive drum **11** with an exposing apparatus **8**. Meanwhile, the toner in a toner storage container **16** is coated in a thin layer on the peripheral surface of the development roller **18** by the development blade **19** held by development unit frame **17**. The toner is two-component toner, that is, a mixture of magnetic toner and magnetic carrier. The development blade **19** regulates the manner in which the toner is coated on the peripheral surface of the development roller **18**. Then, the latent image is supplied (developed) with the toner by applying development bias to the development roller **18** as a developer bearing member. As a result, a visible image is formed on the peripheral surface of the photosensitive drum **11**. Then, the toner image is transferred by the application of bias voltage to a transfer roller **9**, from the photosensitive drum **11** onto the sheet S, which is being conveyed. Then, the sheet S is conveyed to a fixing apparatus **10**, in which the toner image is fixed to the sheet S. Then, the sheet S is discharged by two pairs of discharge rollers **1** into a developer tray **3**, which is a part of the top portion of the apparatus main assembly.

[Structure of Cleaning Unit]

Next, referring to FIGS. **3** and **4**, the structure of the cleaning unit will be described in detail. FIG. **3** is a sectional view of the cleaning unit, and FIG. **4**(*b*) is a front view of the cleaning unit. FIG. **4**(*a*) is a front view of a conventional cleaning unit, and is provided for comparison.

As will be evident from FIGS. **3** and **4**(*b*), the cleaning blade **14** is made up of a metallic plate **14***a* and a rubber portion **14***b*. The metallic plate **14***a* is solidly attached to the frame of the cleaning unit. The rubber portion **14***b* is attached to the metallic plate **14***a*. The material for the rubber portion **14***b* is polyurethane. The rubber portion **14***b* is in contact with the peripheral surface of the photosensitive drum **11**. Thus, as the photosensitive drum **11** rotates in the direction indicated by an arrow mark A in FIG. **3**, the rubber portion **14** removes the toner on the peripheral surface of the photosensitive drum **11**. The removed toner is accumulated in a waste toner chamber **13***a*. The cleaning unit has an elastic sheet **23**, which is pasted on the sheet supporting surface **13***b* of the cleaning unit frame **13**. Thus, the toner remaining on the peripheral surface of the photosensitive drum **11** after the transfer of the toner image is guided into the waste toner chamber **13***a* by the elastic sheet **23**. The elastic sheet **23** is kept lightly pressed upon the peripheral surface of the photosensitive drum **11** just enough to prevent the residual toner in the waste toner chamber **13***a* from passing between the sheet **23** and peripheral surface of the photosensitive drum **11**.

[Solid Attachment of Cleaning Blade]

Next, the method for solidly attaching the cleaning blade **14** will be described. Conventionally, the cleaning blade **14** is attached to the cleaning unit frame **13** as shown in FIG. **4**(*a*). That is, the cleaning blade **14** is precisely positioned relative to the cleaning unit frame **13** by engaging the cleaning blade positioning portion **25**, with which the metallic plate **14***a* of the cleaning blade **14** is provided, with the cleaning blade positioning portion **24** of the cleaning unit frame **13**. The cleaning blade positioning portion **24** of the cleaning unit frame **13** is a boss which is rectangular in cross section, whereas the cleaning blade positioning portion **25** of the cleaning blade **14** is a recess with which the metallic plate **14***a* of the cleaning blade **14** is provided. Thus, as these two cleaning blade positioning portions **24** and **25** engage with each other, the cleaning blade **14** is precisely positioned relative to the cleaning unit frame **13**. Incidentally, in the case of some cleaning units, the cleaning blade **14** is precisely positioned by a combination of a round boss, and a round recess (unshown). The cleaning blade **14** is attached to the cleaning unit frame **13** by putting screws **26** through through holes of the metallic plate **14***a*, and a blind holes or through holes of the cleaning unit **13**, and tightening the screws **26**. Next, referring to FIGS. **4**(*b*) and **8**, in the case of the cleaning unit in this embodiment, the metallic plate **14***a* of the cleaning blade **14** is provided with the through holes **14***c* (blade attach-

ment holes), whereas the cleaning unit frame **13** is provided with bosses **27**. Thus, the cleaning blade **14** is attached to the cleaning unit frame **13** by positioning the cleaning blade **14** so that the bosses **27** fit in the holes **14***c* of the cleaning blade **14**, and then, applying resin.

Next, the attachment of the cleaning blade **14** to the cleaning unit frame **13**, to which the cleaning blade **14** is to be attached, in this preferred embodiment of the present invention, will be described in detail. FIGS. **5**(*a*) and **5**(*b*) show one of the bosses for attaching the cleaning blade **14** to the cleaning unit frame **13**. FIG. **6**(*a*) shows the metallic plate **14***a* and one of the bosses (protrusions) of the cleaning unit frame **13**, in this embodiment, prior to the attachment of the cleaning blade **14**. FIG. **5**(*a*) is a top plan view of the boss **27**, and FIG. **5**(*b*) is a perspective view of the boss **27**. FIG. **6**(*a*) is a sectional view of the metallic plate **14***a* and boss **27**, at a plane indicated in FIG. **5**(*a*) by a single-dot chain line. FIG. **6**(*b*) is a sectional view of the metallic plate **14***a* and boss **27** when the boss **27** is in the hole **14***c* of the metallic plate **14***a*.

The metallic plate **14***a* of the cleaning blade **14** has the cleaning blade attachment holes **14***c*. The cleaning unit frame **13** has the bosses **27**, with which the metallic plate **14***a* is solidly attached to the cleaning unit frame **13**. Each boss **27** is cylindrical and hollow. That is, the end portion of the boss **27** is a cylindrical blind hole, which extends inward from the tip of the boss **27**. The cylindrical wall of the boss **27** is thinner than the wall of the main structure of the cleaning unit frame **13**. The metallic plate **14***a* is placed on the cleaning unit frame **13** so that the bosses **27** come through the cleaning blade attachment holes **14***c*, one for one (FIG. **6**), with the presence of a minute gap **30** between each boss **27** and the wall of the corresponding hole **14***c*, because the boss **27** is slightly smaller in cross section than the hole **14***c* (FIG. **6**(*b*); enlarged view). Next, an resin injection jig **28** is placed on the metallic plate **14***a* so that the boss **27** and hole **14***c* are covered with the jig **28**, as shown in FIG. **7**(*a*). The resin injection jig **28** has a resin injection hole **28***a*, which is in the middle of the top wall of the jig **28**, and through which melted resin **29** is injected inward of the jig **28**. It also has a space in which the boss **27** and hole **14***c* will be as the jig **28** is placed on the metallic plate **14***a*. The melted resin **29** is injected inward of the jig **28** through the abovementioned center hole **28***a*. Since the melted resin **29** (which will cool down and become solid resin **29** after injection) is injected through the center hole **28***a*, the melted resin **29** flows into the adjacencies of the center portion F (portion covered with dots) of the boss **27** (FIG. **7**(*b*)). The wall of the boss **27** is thin as described above. Therefore, as the melted resin **29** is injected, the boss **27** outwardly deforms because of the pressure from the melted resin **29**. Then, the injected melted resin **29** flows into an area G, which is the outward adjacency of the boss **27**, through a gap H which is between the top of the boss **27** and the inward surface of the jig **28**, and fills the abovementioned internal space of the jig **28** (FIG. **7**(*c*)). Then, the jig **28** is moved away, ending thereby the process of attaching the metallic plate **14***a* to the cleaning unit frame **13** (FIGS. **8**(*a*), **8**(*b*), and **8**(*c*)). As the injected melted resin **29** fills the center hole of the boss **27**, surrounds the adjacencies of the hole **14***c* of the metallic plate **14***a*, and solidifies, the metallic plate **14***a* becomes solidly attached to the cleaning unit frame **13**. Further, as the melted resin **29** is injected, the bottom portion of the wall of the boss **27** is expanded as wide as the diameter of the hole **14***c* of the metallic plate **14***a* by the pressure from the injected melted resin **29** as described above. Thus, the metallic plate **14***a* is precisely positioned in terms of the diameter direction of the hole **14***c* of the metallic plate **14** as well (FIG. **8**(*b*); enlarged view).

In this embodiment, the metallic plate **14***a* is solidly attached to the cleaning unit frame **13** with the use of resin, making it possible to eliminate the screws which have been used in the case of the conventional method for attaching the metallic plate **14***a*. Therefore, the abovementioned metallic nuisance (tiny pieces of metal) which might result from the usage of the screws does not occur. Further, the two portions, that is, the positioning portion and attachment portion, which the conventional method for attaching the cleaning blade to the cleaning unit frame require, do not need to be separately provided. That is, in the case of the cleaning blade attaching method in this embodiment, both the metallic plate positioning function and metallic plate attaching function are provided by the same combination of components (boss and corresponding hole), making it possible to reduce the cleaning unit in size, and also, affording more latitude when designing an image forming apparatus (cleaning unit).

Incidentally, in this preferred embodiment, the cleaning unit frame **13** is provided with the bosses **27**, and the cleaning blade **14** is provided with the blade attachment hole **14***c*. Instead, however, the cleaning unit frame **13** may be provided with the blade attachment holes, and the cleaning blade **14** may be provided with the cleaning blade attachment bosses. That is, all that is necessary is that one of the cleaning blade **14** and cleaning unit frame **13** is provided with the holes **14***c*, and the other is provided with the bosses.

Embodiment 2

Shown in FIGS. **9**(*a*) and **9**(*b*) is another preferred embodiment of the present invention. In this preferred embodiment, each of the bosses **127** has four vertical slits which are distributed with even intervals in the circumferential direction of the boss **127**. Each slit extends from the tip of the boss **127** to the bottom of the boss **127**. In other words, the boss **127** has a cylindrical central hole **14***c*, which is similar to the cylindrical central hole **14***c* of the boss **27** in the first preferred embodiment, and four slits (gaps) which extend from the center hole **14***c* to the peripheral surface of the boss **127**.

First, the metallic plate **14***a* is placed against the cleaning unit frame **13** so that each boss **127** fits in the corresponding hole **14***c* of the metallic plate **14***a* (FIGS. **10**(*a*) and **10**(*b*)). Incidentally, the boss **127** is slightly smaller in diameter than the hole **14***c*. Thus, as the boss **127** fits in the hole **14***c*, a small gap **30** remains between the peripheral surface of the boss **127** and the inward surface of the hole **14***c* of the metallic plate **14***a* (FIG. **10**(*b*); enlarged view).

Next, the resin injection jig **28** is placed on the metallic plate **14***a* so that the boss **127** and hole **14***c* are covered with the jig **28**, as shown in FIG. **11**(*a*). The resin injection jig **28** has a resin injection hole **28***a*, which is in the middle of the top wall of the jig **28**, and through which melted resin **29** is injected inward of the jig **28**. The jig **28** has also a space in which the boss **127** and hole **14***c* will be as the jig **28** is placed on the metallic plate **14***a*. The melted resin **29** is injected inward of the jig **28** through the abovementioned center hole **28***a*. Since the melted resin **29** (which will cool down and become solid resin **29** after injection) is injected through the center hole **28***a*, the melted resin **29** flows into the adjacencies of the center portion F (portion covered with dots) of the boss **127** (FIG. **11**(*b*)). As the melted resin **29** is injected, the boss **127** outwardly deforms by being pressed outward by the pressure from the melted resin **29**. Then, the injected melted resin **29** flows into the area G, which is the outward adjacency of the peripheral surface of the boss **127**, through the slits **127***a*, and fills the abovementioned internal space of the jig **28** (FIG. **11**(*c*)). Then, the jig **28** is moved away, ending thereby

the process of attaching the metallic plate **14***a* to the cleaning unit frame **13** (FIGS. **12**(*a*) and **12**(*b*)). As the injected melted resin **29** fills the center hole of the boss **127**, surrounds the adjacencies of the hole **14***c* of the metallic plate **14***a*, and solidifies, the metallic plate **14***a* becomes solidly attached to the cleaning unit frame **13**. Further, as the melted resin **29** is injected, the bottom portion of the wall of the boss **127** is expanded as wide as the diameter of the hole **14***c* of the metallic plate **14***a* by the pressure from the injected melted resin **29** as described above. Thus, the metallic plate **14***a* is precisely positioned in terms of the diameter direction of the hole **14***c* of the metallic plate **14***a* as well (FIG. **12**(*b*); enlarged view). In other words, the second preferred embodiment can provide the same effects as those provided by the first preferred embodiment. In addition, the boss **127** in this embodiment is provided with the slits **127***a*. Therefore, it more easily deforms during the injection of the resin **29**. In this embodiment, therefore, even if the pressure generated by the injection of the resin **29** is lower, the metallic plate **14***a* is precisely positioned relative to the cleaning unit frame **13**.

Embodiment 3

The number of pieces into which each of the bosses of the cleaning unit **13** is to be split does not need to be four as it is in the second preferred embodiment. That is, each boss may be split into two pieces (FIG. **13**(*a*)) like each of the bosses **227**, or more than four pieces (FIG. **13**(*b*)) like each of the bosses **327**, in this preferred embodiment. The same effects as those obtained in the first and second preferred embodiments can also be obtained even in the case where each of the bosses of the cleaning unit frame are split into two pieces, or four or more pieces.

Embodiment 4

The bosses of the cleaning unit frame may be square (FIG. **14**) in cross section, instead of being circular. In this embodiment, each boss is square in cross section, and has multiple (four) sections separated by multiple (four) slits **427***a*. The same effects as those obtainable in the first and second preferred embodiments can also be obtained by a boss such as the boss **427** in this embodiment.

Embodiment 5

Instead of structuring each of the bosses of the cleaning unit frame as if it is split into four pieces by a cross, each boss may be made up of multiple smaller bosses like the eight smaller bosses **527***b*, in this embodiment, which are roughly circularly positioned (FIG. **15**). The same effects as those obtainable in the first and second preferred embodiment can also be obtained even if each of the bosses of the cleaning unit frame is made up of smaller bosses like the bosses **527***b*, in this embodiment, which are roughly circularly positioned.

Embodiment 6

In the preceding preferred embodiments of the present invention, the metallic plate **14***a* is solidly attached to the cleaning unit frame **13** to solidly attach the cleaning blade **14** to the cleaning unit frame **13**. However, the present invention can be applied to attach a development blade **19** to a developing device frame **17** (FIGS. **16**(*a*) and **16**(*b*)). In such a case, effects similar to those obtained in the first preferred embodiment can be obtained by replacing the cleaning blade **14** and cleaning unit frame **13** with the development blade **19** and developing unit frame **17**, respectively. Further, the development blade **19** can be solidly attached to the developing unit frame **17** with the use of bosses like those in the first, second, third, fourth, and fifth preferred embodiments.

In this (sixth) preferred embodiment, the development unit frame **17** is provided with the bosses, and the development blade **19** is provided with the development blade attachment holes. Instead, however, it may be the development unit frame **17** and development blade **19** that are provided with the development blade attachment holes and bosses, respectively.

Further, the preceding preferred embodiments of the present invention were described with reference to the cartridges which are removably mountable in the main assembly of an image forming apparatus. However, the present invention is applicable also to a cleaning device or developing device which is solidly attached to the main assembly of an image forming apparatus. Further, the present invention is applicable to a cleaning device or developing device which is structured so that it is removably mountable in the main assembly of an image forming apparatus.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

This application claims priority from Japanese Patent Applications Nos. 046386/2009 and 286066/2009 filed Feb. 27, 2009 and Dec. 17, 2009, respectively, which are hereby incorporated by reference.

What is claimed is:

1. A cleaning device comprising:

a cleaning blade for removing toner remaining on a surface of an image bearing member;

a cleaning unit frame for supporting the cleaning blade; and

a plurality of projections provided on the cleaning unit frame,

wherein the projections are bent outwardly to secure the cleaning blade to the cleaning unit frame, and

wherein for each of the projections, resin material is disposed in a region between an outer peripheral surface of each respective projection and a surface of the cleaning blade, the resin material being disposed along a line, perpendicular to the cleaning blade, which extends from the outer peripheral surface of the respective projection.

2. The cleaning device according to claim **1**, wherein free ends of the projections are outward of base portions of the projections where the projections are in contact with the cleaning blade.

3. The cleaning device according to claim **1**, wherein gaps are provided between the cleaning blade and the projections.

4. The cleaning device according to claim **1**, wherein the gaps increase toward base portions of the projections.

5. The cleaning device according to claim **1**, wherein a tip portion of each of the projections is entirely covered with a resin material.

6. The cleaning device according to claim **1**, wherein a distance between free ends of the projections is longer than a distance between base portions of the projections where the projections are in contact with the cleaning blade.

7. The cleaning device according to claim **1**, wherein a distance between free ends of the projections is the longest among a distance between other portions of the projections where the projections are in contact with the cleaning blade.

8. The cleaning device according to claim 1, wherein inner surfaces of the projections are in contact with a resin material from a base portion to a free end portion of each of the projections.

9. A cleaning device comprising:

a cleaning blade for removing toner remaining on a surface of an image bearing member;

a cleaning unit frame for supporting the cleaning blade; and

a projection, which is provided on the cleaning unit frame, having a recess,

wherein the recess expands outwardly from a base portion of the projection to a free end of the projection to secure the cleaning blade to the cleaning unit frame, and

wherein resin material is disposed in a region between an outer peripheral surface of the projection and a surface of the cleaning blade, the resin material being disposed along a line, perpendicular to the cleaning blade, which extends from the outer peripheral surface of the projection.

10. The cleaning device according to claim 9, wherein a free end of the projection is outward of the base portion where the projection is in contact with the cleaning blade.

11. The cleaning device according to claim 9, wherein a gap is provided between the cleaning blade and the projection.

12. The cleaning device according to claim 11, wherein the gap increases toward the base portion.

13. The cleaning device according to claim 9, wherein a tip portion of the projection is entirely covered with a resin material.

14. The cleaning device according to claim 9, wherein the recess is filled with a resin material.

15. The cleaning device according to claim 9, wherein the projection is cylindrical.

16. The cleaning device according to claim 15, wherein the cylindrical projection has a wall thickness which is smaller than that of a wall of a main structure of the cleaning unit frame.

17. A developing device comprising:

a developing blade for regulating toner remaining on a surface of a developing roller;

a developing unit frame for supporting the developing blade; and

a plurality of projections provided on the developing unit frame,

wherein the projections are bent outwardly to secure the developing blade to the developing unit frame, and

wherein for each of the projections, resin material is disposed in a region between an outer peripheral surface of each respective projection and a surface of the developing blade, the resin material being disposed along a line, perpendicular to the developing blade, which extends from the outer peripheral surface of the respective projection.

18. The developing device according to claim 17, wherein free ends of the projections are outward of base portions of the projections where the projections are in contact with the developing blade.

19. The developing device according to claim 17, wherein gaps are provided between the developing blade and the projections.

20. The developing device according to claim 19, wherein the gaps increase toward base portions of the projections.

21. The developing device according to claim 17, wherein a tip portion of each of the projections is entirely covered with a resin material.

22. A developing device comprising:

a developing blade for regulating toner remaining on a surface of a developing roller;

a developing unit frame for supporting the developing blade; and

a projection, which is provided on the developing unit frame, having a recess,

wherein the recess expands outwardly from a base portion of the projection to a free end of the projection to secure the developing blade to the developing unit frame, and

wherein resin material is disposed in a region between an outer peripheral surface of the projection and a surface of the developing blade, the resin material being disposed along a line, perpendicular to the developing blade, which extends from the outer peripheral surface of the projection.

23. The developing device according to claim 22, wherein a free end of the projection is outward of the base portion where the projection is in contact with the developing blade.

24. The developing device according to claim 22, wherein a gap is provided between the developing blade and the projection.

25. The developing device according to claim 24, wherein the gap increases toward base portion.

26. The developing device according to claim 22, wherein a tip portion of the projection is entirely covered with a resin material.

27. The developing device according to claim 22, wherein the recess is filled with a resin material.

28. The developing device according to claim 22, wherein the projection is cylindrical.

29. The developing device according to claim 28, wherein the cylindrical projection has a wall thickness which is smaller than that of a wall of a main structure of the cleaning unit frame.

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